

~~Box II, 97.E~~

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~~Box 479~~  
~~Dec. 5. 1868~~  
**CATALOGUE**

OF

**APPARATUS FOR INSTRUCTION**

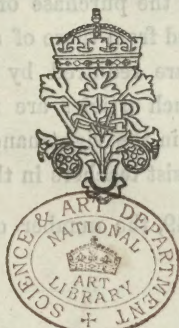
**SUBJECT 1.—Practical Plane and Descriptive Geometry.**

**SUBJECT 2.—Mechanical and Machine Drawing.**

**SUBJECT 3.—Building Construction or Naval Architecture.**

**SUBJECT 6.—Theoretical Mechanics.**

**SUBJECT 7.—Applied Mechanics.**



**LONDON :**

**PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,**

**PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.**

**FOR HER MAJESTY'S STATIONERY OFFICE.**

**1868.**

22. 4. 68.

## INSTRUCTIONS.

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All applications for apparatus are to be made on Science Form, No. 49, which will be supplied on application to the Secretary, Science and Art Department, South Kensington.

Orders from different tradesmen must be made on separate forms.

The prices given in the right-hand column are the highest on which the aid of 50 per cent. is given. The applicant is at liberty to select a higher priced article, but the aid towards the purchase of it will be only 50 per cent. of the price in the right-hand column. Should a lower priced article be selected the aid will be only to the extent of 50 per cent. of its price.

Apparatus grants are rigorously confined to articles of a permanent and non-destructible nature; hence no aid is afforded in the purchase of breakable articles, such as glass retorts, test tubes, &c., or indeed generally in the purchase of articles to be used by the student as distinguished from those of a permanent and illustrative character which are required by the teacher in giving instruction in science. Such articles are not numbered, and no prices are affixed to them in the right-hand column; the articles are mentioned simply to assist teachers in their selection.

N.B. In filling up No. 49, the number of the apparatus must always be mentioned.

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# CATALOGUE

## PREFACE.

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IN the following lists no additional apparatus to that in general use is recommended for subjects 1, 2, and 3, except a few Dissected Models of the oblique prism, pyramid, and cone. To render these models useful the teacher should accompany them with diagrams carefully drawn on pasteboard, capable of bending so as to represent the two planes of projection. By placing each model on the corresponding figure on the diagram the teacher could explain to his pupils the principle on which plans, elevations, and sections are drawn, and so dispense with the more costly models of buildings and machinery. When the student is well grounded in Practical Solid Geometry, he will be able to draw such objects from copies, or the objects themselves.

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## APPENDIX

In the following list are additional apparatuses to that in General use is recommended for subjects 1, 2, and 3, except a few illustrated models of the oblique prism, pyramid, and cone. To render these models useful the teacher should accompany them with illustrations very fully drawn on poster-board, capable of holding as to represent the two planes of projection. By placing each model on the corresponding figure on the diagram the teacher could explain to his pupils the principle on which plane, elevation, and section are drawn, and so likewise with the more costly models of solid-logs and machinery. When the student is well grounded in Practical Solid Geometry, he will be able to draw such objects from copies or the objects themselves.

# CATALOGUE.

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## SUBJECTS I., II., III.—Apparatus for teaching Geometrical Drawing.

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### Elliot, Brothers, 30, Strand, W.C.

- Case of drawing instruments, 5s. 6d.
- Ditto 15s. 0d.
- Rolling parallel ruler, from 10s. to 1l. 10s. 0d.
- Large wooden compasses for black board, 3s. 6d.

### Pastorelli & Co., 208, Piccadilly W.

- Rolling parallel rulers, from 12s.
- Ivory scales for architectural drawing, from 10s.
- Box do. do. 6s.
- Set of drawing instruments, 3s.

### Newton & Co., 3, Fleet Street, E.C.

- Case of drawing instruments, 3s. 6d.
- Ditto 6s. 6d.
- Ditto 10s. 6d.
- Rolling parallel rulers, per inch, 9d.
- Large brass compass for black board, 2s. 6d.

### Cronmire & Co., 10, Cottage Lane, Commercial Road, E.

- Case of drawing instruments, 2s. 6d.
- Ditto 7s. 0d.
- Ditto 12s. 6d.

### T. Grew, 3, High Street, Stratford, E.

- Case of drawing instruments, 2s. 6d.
- Ditto 14s. 0d.

### C. Lefever, 14, Duncan Place, Hackney, N.E.

- Case of drawing instruments, 4s. 5d.
- Ditto 10s. 0d.

### Parkes & Son, 5, St. Mary's Row, Birmingham.

- Box of drawing instruments, introduced by W. H. Hyett, Esq., F.R.S., for the instruction of the boys in the Painswick Science School, 2s. 6d.
- Ditto, 10s.

### Hachette & Co., 18, King William Street, Strand, W.C.

- Case of drawing instruments, 1s. 6d.
- Ditto, 2s. 6d.
- Ditto, 4s. 10d.
- Ditto, 15s. 2d.
- Large wooden compasses for black board, 3s. 6d.



**A. Davis & Co., 58, Hounsditch, E.C.**

Case of drawing instruments, 3s.

Ditto 7s.

**W. F. Stanley, 3, Great Turnstile, Holborn, W.C.**

12-inch ivory scale, for architectural drawing, 6s.

12-inch rolling parallel ruler, ivory edged, 10s.

N.B. A plain ruler and triangle of pear wood or box are preferable, for drawing parallel lines, to a learner. Price complete, 1s.; by W. F. Stanley (above).

**J. R. Larkin, Elm Cottage, Old Brompton Road, S.W.**

|     |  | Price on which 50 per cent. is allowed. |    |        |
|-----|--|---|----|--------|
|     |  | £                                       | s. | d.     |
| 1.  | Cone with five sections, eight inches  | -                                       | -  | 1 1 0  |
| 2.  | Cone with three sections, five inches  | -                                       | -  | 0 5 0  |
| 3.  | Hexagonal prism, with oblique section, eight inches  | -                                       | -  | 0 5 0  |
| 4.  | Hexagonal pyramid ditto  | -                                       | -  | 0 5 0  |
| 5.  | Cylinder ditto   | -                                       | -  | 0 5 0  |
| 6.  | Cube, six inches   | -                                       | -  | 0 3 6  |
| 7.  | Octahedron, do.  | -                                       | -  | 0 3 6  |
| 8.  | Tetrahedron, do.   | -                                       | -  | 0 2 6  |
| 9.  | Dodecahedron, do.  | -                                       | -  | 0 4 6  |
| 10. | Icosahedron, do.   | -                                       | -  | 0 4 6  |
| 11. | Engineer and machinist's drawing book, 71 plates, published, mounted back and front on mill-board 15 by 12 inches. | -                                       | -  | 3 4 0  |
| 12. | The same, sewed in numbers, at 2s. per number  | -                                       | -  | 1 12 0 |
| 13. | Bradley's Elements of Geometrical Drawing, part 1.   | -                                       | -  | 0 16 0 |
| 14. | Ditto ditto part 2.  | -                                       | -  | 0 16 0 |

**James Rigg, Engineer and Ironfounder, George Street, Chester.****GEOMETRICAL DRAWING.**

- |     |   |        |
|-----|---|--------|
| 15. | Box containing Cube, Square, and Hexagonal Prism, Square-base and Hexagonal Pyramid, Cone, Cylinder, Sphere, Triangle, Square, Pentagon, Hexagon, Circle, Gothic Arch, and Cross, with Spring Holder and Stand, improved so that the Models may be placed at any given angle with reference to the horizontal or vertical Planes. | 1 10 0 |
| 16. | Improved Spring Holder and Stand  | 0 3 6  |

When the foregoing Set of Models is intended for general or class instruction, it is recommended that more than one spring holder and stand be provided.

## James Rigg—continued.

A series of Objects with Plans and Elevations, showing Sections and Modes of Projection, with the lines of construction, is arranged for the above purpose. The Sections, Penetrations, and Intersections of regular, irregular, and curvilinear Solids are worked out as a development of the ordinary mechanical drawing. It is expected that a pupil who has studied the series, and himself worked out the results, will be competent for the requirements in an Engineer's Drawing Office.

Descriptions and illustrations of some of these Models and Tables may be found in the works of M. Le Blanc or MM. Armengaud, or in the English works based on these, viz., The Engineer and Machinist's Drawing Book, published in folio, by Blackie & Son, 1855, plates, 1, 2, 3, 4, 5, 6, 7, 8.

17. A complete set of these models, in 40 tables, with illustrative drawings of each, forming an easily graduated series of lessons.

A selection from the above, as in "The Engineer and Machinist's Drawing Book," consisting of:

Plates.

1, 2, 3. Pyramids, Prisms, and Conic Sections.

4, 5, 6. Intersections and Penetrations of Rings, Spheres, and Cones.

7. Helices and Screws.

8. Thirty Shaded Projections.

These Plates are illustrated by tables as under:—

|     |  |   |    |       |    |        |
|-----|--|---|----|-------|----|--------|
| 18. | 1  | 1 | 1  | ..... | 4  | 0 17 6 |
| 19. | 2  | 1 | 5  | ..... | 8  | 0 17 6 |
| 20. | 3  | 2 | 1  | ..... | 6  | 0 17 6 |
| 21. | 4  | 3 | 1  | ..... | 6  | 0 17 6 |
| 22. | 5  | 4 | 1  | ..... | 4  | 0 17 6 |
| 23. | 6  | 4 | 5  | ..... | 8  | 0 17 6 |
| 24. | 7  | 5 | 9  | ..... | 12 | 0 17 6 |
| 25. | 8  | 5 | 13 | ..... | 14 | 0 17 6 |
| 26. | 9  | 6 | 15 | ..... | 18 | 0 17 6 |
| 27. | 10   | 6 | 19 | ..... | 22 | 0 17 6 |
| 28. | 11   | 7 | 1  | ..... | 5  | 0 17 6 |
| 29. | 8 containing a selection of fifteen of the above series as illustrations for engineering shading, but without the tables   |   |    |       |    | 5 10 0 |
| 30. | A selection from the large set, consisting of six tables, as illustrative of the Orthographic Projection, or engineering drawing of points, lines, or developable surfaces. These may be used as a study before the commencement of the selection introduced in the Engineer and Machinist's Drawing Book. |   |    |       |    | 3 16 0 |

£ s. d.

35 0 0



## James Rigg—continued.

Drawing boards :—These boards are made of prepared timber, upon an entirely novel plan ; and, from experiments it is expected that the warping or casting frequent in new drawing boards is thus overcome. They are very light, and the edges are formed of a hard wood. The T squares which accompany them are so constructed as to allow the set squares and other instruments used on the boards to pass over the stock of the square. The stock is made to bear upon the middle, and not upon the corner of the edge ; thus, not only are the edges more durable, but accidental injuries to the corners of them do not affect the truth of the T square when in use.

£ s. d.

|   |   |   |    |
|---|---|---|----|
| 31. Board, measuring 2 ft. 6 in. × 1 ft. 9 in.                      | 0 | 8 | 6  |
| 32. " " 1 ft. 10 in. × 1 ft. 5 in.                                  | 0 | 5 | 6  |
| 33. " " 1 ft. 4 in. × 10½ in.                                       | 0 | 2 | 6  |
| 34. T square, adapted for the first board                           | 0 | 2 | 0  |
| 35. " " second "  | 0 | 1 | 6  |
| 36. " " third "   | 0 | 0 | 10 |
| 37-39. { T squares with brass edges, double the price of the above. |   |   |    |

Black boards :—These are mounted on a vertical iron axis accurately turned, and revolving in a metal bearing provided with an iron clamping screw, hence objects drawn on either side are always in a proper position. If desired, the black board may be removed, and its place supplied by a teacher's desk, or a revolving table for the exhibition or examination of large casts or models.

|  |   |         |       |    |   |
|--|---|---------|-------|----|---|
| 40. Black board, 3 ft. × 3 ft. and stand                                       | - | -       | 1     | 5  | 0 |
| 41. " " 3 ft. 6 in. × 3 ft. "  | - | -       | 1     | 7  | 6 |
| 42. " " 4 ft. × 3 ft. "  | - | -       | 1     | 10 | 0 |
| 43. " " 4 ft. × 3 ft. 6 in. "  | - | -       | 1     | 12 | 6 |
| 43. Revolving table and desk (with stand)                                      | - | -       | 1     | 11 | 6 |
|  |   |         | Pine. |    |   |
| 45-6. Slip, or straight-edge, 3 ft. long                                       | - | 0s. 6d. |       |    |   |
| 47-8. Large triangle   | - | 1       | 0     |    |   |
| 49-50. Small   | - | 0       | 8     |    |   |
| 51-2. T square, 3 ft. long   | - | 1       | 0     |    |   |
| 53-4. " with blade moveable, so as to draw lines parallel at any angle         | 1 | 3       |       |    |   |
| 55. Large compasses, with crayon holder, and improved joint for steady motion. |   |         |       |    |   |

Mahogany.

0 0 8

0 1 3

0 1 0

0 1 6

0 3 0

0 3 6

Universal holder for models on a large scale. These holders, and the accompanying models, are so arranged that examinations of schools in object drawing may be carried on by printed or written papers. The questions may be set, and so the position of the object, with reference to any of the three geometrical planes, be accu-



## James Rigg—continued.

rately fixed. This holder is also convenient for class teaching, for by a single memoranda of angles the model or object can, on any future day, be placed in any previously recorded position.

56. Universal holder, of metal, to stand on floor, with large strong tripod base.

£ s. d.

1 2 6

## MECHANICS.

Various sectional and other working model diagrams have been arranged for class teaching. They are specially adapted for use in Schools and Institutions, and from the peculiar form of the support, *many may be hung against the wall as paper diagrams, or set upon a table and put in action.* They are strong, being constructed of wood and metal. The motion of the parts and consequences of that motion are distinctly visible to a very large class. A teacher will find that by such models the attention is readily secured, and the study of machinery rendered much more clear and interesting.

The free and clear action of large working picture or diagram models gives a power of illustrating which no printed or coloured drawings possess. They have been long and successfully used in the Training College, Chester. It must be understood that they are arranged solely for Educational use, and manufactured by Mr. Rigg, as cheaply as is consistent with good and accurate workmanship.

57. Sectional wooden model diagram of a pump, size 3 ft. by 1 ft.; the valves open and close, so that their action is clearly seen

0 12 6

58. Sectional wooden model diagram of steam engine, which can be placed before a class, either as a horizontal, vertical, marine, or locomotive engine; the arrangement and action of the slide valve, eccentric, piston, crank, fly wheel, &c., are clear. Size, 4 ft. by 1 ft. 8 in.

1 5 0

59. Sectional wooden model diagram of gas meter, size, 1 ft. 4 in. by 1 ft.

0 12 6

- 60 to 64. Five sectional wooden model diagrams, of various parallel motions for steam engines, size of each, 1 ft. 9 in. by 1 ft. 3 in. 6s. each.

1 10 0

65. Sectional wooden model diagram of a corn thrashing machine, with beater, straw-shaker, riddle, &c., &c., complete, to show the process of separating grain and chaff from straw, and preparing it for winnowing; size, 1 ft. 9 in. by 1 ft. 9 in.

1 0 0

66. Sectional wooden model diagram of a winnowing machine, for separating chaff, small seeds, and small grain from large grain, and depositing each in different receptacles, &c.; size, 1 ft. 9 in. by 1 ft. 9 in.

1 0 0

## James Rigg—continued.

|   | £ | s. | d. |
|---|---|----|----|
| 67. Sectional wooden model diagram of a cornmill, including every process from the grain being put into the hopper to its being deposited in sacks as fine flour, seconds, or bran. The regulating the supply, the varying distances of the millstones, the creeper, hoist, separator, dresser, &c., &c., can all be put in motion at the same time, that a large class may observe every process; size, 2 ft. 4 in. by 2 ft. 4 in. | 2 | 5  | 0  |
| 68. Sectional wooden model diagram of a machine for morticing and tenoning timber, as an illustration of the power of a combination of links and levers. This machine is in very general use for making gates, doors, frame-work, &c., &c. The model is one-third of the full size; size, 2 ft. 6 in. by 1 ft.  | 0 | 6  | 0  |
| 69. Sectional wooden model diagram of a door-lock and key, showing the mode in which the various parts are arranged, and how the key moves the tumblers, bolt, &c., &c.; size, 1 ft. 3 in. by 9 in.   | 0 | 10 | 0  |
| 70. Sectional wooden model diagram of an organ, containing great organ and swell. Not only is the action of the respective parts clearly seen, but the great organ and swell may be combined, and the construction of reed, metal, and wooden pipes may be studied from the actual pipes.<br>Working model of the action of a pianoforte; size, 1 ft. 9 in. by 1 ft. 3 in.  | 4 | 0  | 0  |
| 72. Working illustration of the link motion and reversing gear, as used in locomotive, marine, and other steam engines; size, 2 ft. by 1 ft.  | 0 | 7  | 6  |
| 73. Working illustration of the electric telegraph, the one side showing how the currents are reversed, and the other how, consequently, signals are transmitted. The direction of the current is shown by arrows. Size, 1 ft. 9 in. by 1 ft.   | 1 | 0  | 0  |
| 74. The binomial cube, in a box, to show by experiment that—<br>$(a+b)^2 = a^2 + 2ab + b^2 \quad (a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$   | 1 | 2  | 6  |
| 75. Fifty joints in hard wood, being a selection of the chief of those used by architects, carpenters, cabinet makers, and others.<br>Mensuration board for class or lecture room teaching. The scales on this board are—<br>The slide rule; two Vernier scales; a diagonal scale; a jointed sector; a scale with the principle of the Vernier as a simple substitute for the diagonal scale.                                       | 0 | 6  | 0  |
| 76. Questions may be solved with these scales by members of a class, or a teacher in their presence. Size of board, 3 ft. by 3 ft.  | 5 | 0  | 0  |
| 77. Stand for the above as a black board -  | 1 | 17 | 6  |
|   | 0 | 17 | 6  |



James Rigg—*continued.*

£ s. d.

- The whole of the following articles, 78 to 121 inclusive, have been prepared from models made under the direction of Professor Willis, at the request of the Department of Science and Art. A set of mechanical powers, also adapted for the illustration of other principles of statics:—
78. Lever.—Stand, two counterpoise levers; balanced lever, divided into 2-inch parts; two wire pins for supporting levers; four hooks, and Archimedean lever.
- Wheel and axle.—Cardboard disc, 1 ft. 3 in. in diameter; wooden stand; two strings for supporting weights, 3 ft. long, and two 1 ft. 6 in. long; one brass pin.
- Pullies.—One cross-bar to fasten to pulley-post, two 3-sheaved, two 2-sheaved, and one 1-sheaved pulley; one moveable pulley.
- Inclined plane.—Graduated plane, with variable sides; two pulley-posts; one moveable pulley; lead roller,  $\frac{3}{4}$  in. in diameter and  $2\frac{1}{2}$  in. long, weight five-tenths of a pound.
- Wedge.—Wooden frame, and two wedges; weight of each five-tenths of a pound.
- Screw.—Two sheet-iron screws, 8 ins. in diameter, and one 4 ins. in diameter, with wooden stand, pulley-post, &c.
- Parallelogram of forces,—illustrated.
- Sundries belonging to the above set:—three cast-iron tripods for supporting apparatus; three  $\frac{3}{8}$  ins. bolts and winged nuts; one board for pullies; two boards for winding strings upon, and one box for weights, containing three weight-holders (weight of each one-tenth of a pound), and 10 weights, each one-tenth of a pound.
79. Iron tripod stands for attaching apparatus:  
No. 1, small size (the same as in the above set), with bolt and winged nut. 7 10 0
80. No. 2, much larger size. 0 3 6
81. The foregoing are also useful as the feet of stands for supporting diagrams, &c.—Plain wooden uprights for these purposes, 1s. each. 0 6 0
82. A set of apparatus to demonstrate and illustrate the construction, pressures, and tensions of the three legs or triangle, shears, and derrick. Also to show the amount of pressure distributed by a given weight upon each of the three legs of a table. 0 1 6
83. Knee-joint or dog-leg lever of iron, arranged to show, by the action of a very small weight, its great mechanical advantage. This construction has been generally used in printing presses, and recently patented by Messrs. A. & J. Rigg, as applied to wood morticing machines. See No. 68. 1 10 0
- 1 2 0

James Rigg—*continued.*

|  | £  | s. | d. |
|--|----|----|----|
| 84. Drop box to let fall simultaneously two large balls of cork and lead. It may be hung on a nail in a wall, and gives more satisfactory results than the so-called guinea and feather apparatus. | 0  | 16 | 6  |
| 85. Double Atwood machine, arranged for the performance of the usual experiments in a more striking manner than with the ordinary form of this apparatus.  | 13 | 2  | 6  |
| 86. Pendulum and independent stand for the above, arranged with adjustments to beat seconds—may be used in all <i>experiments where brief intervals of time have to be noted.</i>                  | 1  | 6  | 0  |

## KINEMATICAL APPARATUS OR ELEMENTARY PARTS OF MECHANISM.

N.B.—The references are to the articles in "Principles of Mechanism," by Professor Willis. Published by J. W. Parker.

|  |   |    |   |
|--|---|----|---|
| 87. Rotatory or oscillatory motions, with varying velocities from the same apparatus as produced by <i>link-work</i> in iron, with discs and iron tripod stand. (Art. 300.)  | 1 | 2  | 6 |
| 88. Eccentric pin and slit bar, with discs and iron stand to produce the same motions as the above by <i>sliding</i> contact. (Arts. 290 and 364.)   | 1 | 2  | 6 |
| 89. The quick-return motion, derived from No. 10, as used in Whitworth's shaping machine and other tools, all the motion parts being shown. (Art. 364.)  | 0 | 17 | 6 |
| 90. Rod reciprocating by means of an eccentric pin and link, arranged so as to show the variations of its motion which arise from different lengths of links, and also to exhibit "Booth's Motion," (patented in 1843,) useful in illustrating many of the conditions of motion of the piston and slide valve of the steam engine, &c. (Partly described in Art. 328.) | 2 | 0  | 0 |
| 91. Link-work connecting two parallel axes with side rods, employed for connecting the wheels of locomotive engines. (Art. 198.)   | 0 | 16 | 6 |
| 92. Link-work to show Boehm's motion, by which three straight bars and two face plates are employed to communicate equable rotation from one shaft to another parallel thereto. (Art. 200.)  | 0 | 16 | 6 |
| 93. Alternate intermittent motion, produced by link-work from a single axis of rotation. (Art. 336.)   | 0 | 18 | 6 |
| 94. Motions illustrating the action of the pedal of the harp (as an example of link-work), showing how the flat, natural, or sharp note is obtained by the continuous depression of the same pedal. (Art. 334.)  | 0 | 12 | 0 |



## James Rigg—continued.

|  | £ | s. | d. |
|--|---|----|----|
| 95. Oscillations multiplied by an arrangement of straight links connected with a common crank. (Art. 335.)   | 0 | 12 | 0  |
| 96. Variable link-work, showing a mode by which the path of a reciprocating piece may be increased or diminished, or entirely suspended without altering or stopping the prime mover. (Art. 483.)  | 0 | 18 | 6  |
| 97. Combination of Hook's joints in iron, showing the effect of different inclinations of the axes, and supplying means for observing the relative velocities in each portion of the rotation. (Arts. 301 and following.)  | 2 | 4  | 0  |
| 98. Two spur wheels of wood, with teeth of the epicycloidal form, and of large size, prepared with surfaces, showing the nature and direction of transmitted pressure during their sliding contact, and all the circumstances of their mutual action, the varying position of the points of contact with reference to the line of centres and pitch circle, &c., &c. | 0 | 18 | 6  |
| 99. Odontograph, in brass, either for actual use in the formation of wheel and rack patterns, or for educational use in teaching the general principles adopted in the formation of the teeth of wheels. (Art. 141 and following.)   | 1 | 2  | 0  |
| 100. Model to illustrate the action of "skew bevils," for communicating motion between axes whose directions neither meet nor are parallel.<br>By this apparatus it can be shown that the motion is obtained from the contact of portions of two hyperboloids, the generating lines of which determine the oblique position of the teeth.                            | 0 | 16 | 6  |
| 101. Set of three eccentric and elliptic toothed wheels. (Art. 271 and following.)   | 0 | 18 | 6  |
| 102. Pair of ellipses, to explain the mode of obtaining the pitch circles of the above, and general principle of rolling contact. (Art. 259.)  | 0 | 12 | 6  |
| 103. Model of a conical toothed wheel and toothed cone to produce a rotation with varying velocity upon Roemer's principle. (Art. 280.)  | 1 | 2  | 0  |
| 104. Intermittent motion by hoop and pin wheel, showing a method by which machinery may be locked or fixed except at the instant of motion; thus any shaft or apparatus may be firmly held until some other shaft has made a revolution.   | 0 | 18 | 6  |
| 105. Continuous slow motion (designed by R. Roberts, of Manchester) which may be used for counting the number of revolutions of a shaft, and consisting of a pin and plate with semicircular teeth.  | 0 | 16 | 6  |
| 106. Transmission of axial motion by means of a face-plate with cross grooves, contrived about 1841, name of inventor unknown.   | 0 | 16 | 6  |

James Rigg—*continued.*

|  | £ | s. | d. |
|--|---|----|----|
| 107. Reciprocating motion produced by a triple tooth rack; this was used about the year 1690. (Art. 366.)  | 0 | 12 | 0  |
| 108. Reciprocating motion produced by a double rack and segmental teeth. (Art. 323.)   | 0 | 18 | 6  |
| 109. Mangle wheel reciprocating motion. (Art. 315, &c.)  | 0 | 18 | 6  |
| 110. Worm-wheel and worm, on Hindley's principle, having many teeth in contact. (Art. 174.)  | 1 | 2  | 0  |
| 111. Screw returning into itself; used for the uniform and alternate traverse of a rod for such purposes as laying the thread on the bobbin in spinning. (Art. 361.)   | 0 | 16 | 6  |
| 112. Model, with a set of shifting slides and cams to explain and illustrate the different forms and actions of plane cams and tappets, and the principal kinds of motion which they are employed to produce.  | 1 | 14 | 0  |
| 113. Heart-shaped cam in action between two friction rollers upon one oscillating bar, and producing equable motion in both directions; the curves are involutes of the circle. (Art. 161.)  | 0 | 12 | 6  |
| 114. Boiler-punch, showing how, by a properly constructed cam, the greatest power of the machinery may be applied in the act of punching; the punch <i>then</i> rapidly raised— <i>then</i> remain at rest for a portion of a revolution until the work is readjusted— <i>then</i> descend rapidly until near the work, when the velocity may be said to be changed into power; this is provided with a cutter which may be applied to thin card-board, or letter paper.                       | 1 | 5  | 0  |
| 115. Cam, arranged in the form of a groove on the face of a wheel to show how a law of varying velocity may be given to the end of a vibrating link or rod. (Art. 357.)  | 0 | 16 | 6  |
| 116. Silent click, showing the method of getting rid of the noise and consequent wear of the clicks in ratchet work. (Art. 350.)   | 1 | 2  | 0  |
| 117. The principle of calculating machines, illustrated by a working model for addition and subtraction, to three places of figures, as an example of ratchet work. The method is that adopted for stamping progressive numbers on railway tickets or paging books.  | 1 | 7  | 0  |
| 118. Model to illustrate various conditions of wrapping contact or endless band motions. By this apparatus may be explained the use of a weighted or spring stretching pulley, also the effect of a cam action upon a wrapping connexion, and how variable intermittent, or alternate, or partly progressive, or partly retrograde, motions may be communicated to one pulley from another which revolves uniformly, and is connected to the former by an endless band. (Arts. 177, 297, 375.) | 1 | 2  | 0  |



## James Rigg—continued.

|   | £ | s. | d. |
|---|---|----|----|
| 119. Model to illustrate the consequences of rotating the point of suspension of a cord passed round a single moveable pulley—also the differential action of an axle with two wheels of different diameters. | 0 | 16 | 6  |
| 120. Folding diagram in cardboard, to show the principle upon which are arranged guide pulleys to convey an endless band from one wheel to another when their axles are not parallel. (Art. 187.)             | 0 | 5  | 0  |

121. A complete set of mechanical apparatus for building up experimental machinery upon the plan described by Professor Willis in his "System of Apparatus for the use of Lecturers and Experimenters in Mechanical Philosophy," published by Weale.

This apparatus is strong; and actual working machines of all descriptions, as clocks, mangles, cranes, &c., &c., may be constructed of the parts.

The following are the prices at which the separate parts can be supplied. They may be used as examples of pieces of machinery for students in engineering drawing, or for the purposes of illustration by lecturers or experimenters in mechanical philosophy. The number of each article ordered must be determined by the purposes for which they are required.

The reference numbers are to the plates in the work referred to.

|          |   |      |   |    |   |
|----------|---|------|---|----|---|
| Fig.     |   |      |   |    |   |
| 1 to 6.  | Cast-iron brackets, bored and fitted    | each | 0 | 3  | 0 |
| 7.       | Clamps (various sizes)                  | -    | 0 | 4  | 6 |
| 8.       | Wrought-iron stud and nut               | -    | 0 | 3  | 0 |
| 8 & 13.  | Cast iron socket and nut                | -    | 0 | 4  | 0 |
| 9.       | Reducing stud and nut                   | -    | 0 | 4  | 0 |
|          | "    " brass socket and nut             | -    | 0 | 6  | 0 |
| 16.      | Slit table, in wood                     | -    | 0 | 16 | 0 |
| 17 & 18. | Sole, block, and base board             | -    | 0 | 4  | 0 |
| 19.      | Cast iron rectangle                     | -    | 0 | 3  | 0 |
| 20.      | Wooden beds, per lineal foot            | -    | 0 | 1  | 3 |
| 21 & 22. | Wrought iron loops, various forms, each | -    | 0 | 6  | 6 |
| 23.      | Side frame for stool                    | -    | 0 | 11 | 0 |
| 24.      | Stool or stand table                    | -    | 6 | 11 | 6 |
| 29.      | Tube fittings, in brass                 | -    | 0 | 7  | 6 |
| 30.      | Cast iron shaft ring with pins          | -    | 0 | 3  | 6 |
| 31.      | Clamp pulley (slightly altered)         | -    | 0 | 3  | 0 |
| 32.      | Flange and fittings                     | -    | 1 | 12 | 0 |
| 33.      | Adapter                                 | -    | 0 | 3  | 6 |
| 34.      | Lever arm                               | -    | 0 | 6  | 6 |
| 35.      | Shaft in carriage with brasses          | -    | 1 | 16 | 0 |
| 36.      | Brass lengthener for 35                 | -    | 0 | 7  | 6 |
| 37.      | Brass coupler for 35                    | -    | 0 | 4  | 6 |

## James Rigg—continued.

| Fig. |  | £ | s. | d. |
|------|--|---|----|----|
| 38.  | Wrought-iron pulley bearings - each  | 0 | 18 | 0  |
|      | Thumb or winged nuts - " "   | 0 | 0  | 6  |
|      | Hexagonal nuts - " - per lb.   | 0 | 0  | 8  |
|      | Bolts $\frac{3}{8}$ , $\frac{1}{2}$ , or $\frac{3}{4}$ - " - " "                       | 0 | 0  | 8  |
|      | Wrought-iron keys for nuts - each  | 0 | 4  | 0  |
|      | Spur, bevil, or mangle wheels, turned, bored, and finished; plate wheels - " - per lb. | 0 | 0  | 6  |
|      | Do. arm " - " "  | 0 | 0  | 8  |
|      | Pedestals with brass bushes and cast iron caps, bolts, and nuts - " "                  | 0 | 1  | 0  |
|      | Plain shafts, turned and polished - " "  | 0 | 0  | 5  |
|      | Washers, any size, with edges turned - " - " "   | 0 | 0  | 4  |

Separate parts of any machinery fitted up for either actual use or as studies for students in engineering drawing.

N.B.—TERMS: Cash on delivery in Chester.

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